

*Velocity in the Line of Sight. Selected Stars. Cambridge Observatory, II. 1903. By H. F. Newall.*

The present note is a second contribution to the plan of co-operation between certain observatories to determine the velocity in the line of sight of selected stars. Since the first contribution (*Monthly Notices*, vol. lxiii. p. 296) no alterations have been made in the instrument, but a fuller description of it than has yet been given is published in the present number of the *Monthly Notices*, p. 636. Fuller details of the measurements will, it is hoped, shortly appear in the *Astrophysical Journal*; only the results of the measurements are given here, together with a summary of the mean velocities of the nine stars dealt with.

The year 1903 was unfavourable for observations; the brighter stars were often accessible only by longer exposures than usual, but the photographs of the spectra of fainter stars could hardly be obtained with the linear dispersion given by the four prisms and the medium camera (focal length 520 mm.). As it was regarded as particularly desirable to get spectra of the fainter stars on the list such as  $\beta$  *Ophiuchi* (Draper Catalogue magnitude at  $H\gamma$  4.19),  $\gamma$  *Aquilæ* (D.C.M. 4.66), and  $\gamma$  *Piscium* (D.C.M. 5.03), the shorter camera (Dallmeyer Doublet, focal length 356 mm.), was put on in place of the medium. My assistant, Mr. Bellamy, made the most praiseworthy efforts to secure measurable photographs, and succeeded in getting six photographs of  $\beta$  *Ophiuchi* and  $\gamma$  *Aquilæ*; but the sky was never clear enough to make it worth while to attempt to secure photographs of  $\gamma$  *Piscium*.

The velocities deduced for  $\beta$  *Ophiuchi* and  $\gamma$  *Aquilæ* must be regarded as of inferior weight; for the photographs are weak even compared with those got since (in 1904) with the medium camera.

The measurements have been made under my directions by Mr. Bellamy, illness having prevented me from carrying out my intention of making the measurements in duplicate. I am much indebted to Mr. Bellamy for his continued efforts under circumstances that must have been peculiarly discouraging to him.

In the record of the photographs given below

Fm denotes those taken with the medium camera (520 mm.)

Fs        „        „        „        shorter        „        (356 mm.)

The velocities deduced in the Fs series seem to be more or less consistently about 2-3 km/sec lower than those deduced in the Fm series. I have not been able to assign a cause for this, and have accordingly given the results as deduced from photographs obtained with all due care. The difference appears also in the case of  $\alpha$  *Boötis*, though the results are not given below.

It should be stated that the instrument is not provided with electrical temperature control, but is only encased in a thick quilted feather cover. As instances of the success of this cover, the following records are of interest, though the electrical control would give results of a different order :

No. of Photograph.	Month.	Exposure.	Temperature on case of Prism-box. Beginning of Exposure.	End of Exposure.
Fm 394	Feb.	<sup>m</sup> 70	11.7° C.	11.3
Fm 413	Mar.	50	4.1	3.9
Fm 415	Mar.	120	5.6	4.5
Fm 422	Apr.	22	7.0	7.1
Fm 425	Apr.	25	7.2	7.1
Fm 440	May	70	11.7	11.3
Fs 482	July	67	12.0	11.3
Fs 487	Aug.	80	16.9	16.0
Fs 488	Aug.	75	15.5	15.0
Fs 505	Oct.	80	9.8	9.5
Fs 525	Nov.	28	6.8	6.5
Fs 534	Dec.	50	0.3	0.3
Fs 540	...	37	3.2	3.0

A special temperature control has not been fitted to the instrument, not because I think it unnecessary, but because I had the intention to remodel the whole instrument; and I desired to give a trial of a plane-grating spectrograph [which is being constructed and is nearly ready for use] before doing this.

Star and No. of Plac.	Date and G.M.T. Mid-exposure.	Exposure.	Hour-angle.	Slit-width.	Range of Spectrum.	Comp. Spect.	No. of Lines.	Velocity relative to Earth.	Velocity reduced to Sun.	Mean Error.
$\alpha$ Arietis, 1903.		h m	m	mm.				km/sec.	km/sec.	co.
Fs 494	Sept. 26	9 56	43 4 11 E	{ 0.025 (m=3)	4202 4405	Fe Spk.	10	-30.27	-14.23	± 1.38
Fs 504	Oct. 13	11 17	45 1 44 E	"	"	"	15	-21.47	-13.30	± 1.25
Fs 506	16	12 0	50 0 52 E	"	"	"	14	-22.59	-15.94	± 1.10
Fs 508	21	8 55	40 3 32 E	"	"	"	14	-21.41	-17.05	± 1.18
Fs 510	23	11 48	47 0 34 E	"	"	"	13	-18.79	-16.67	± 1.04
Fs 513	28	9 20	50 2 42 E	"	"	"	13	-18.93	-18.25	± 1.11
Fs 534	Dec. 1	10 45	50 0 57 W	"	"	"	13	+ 0.39	-15.79	+ 0.98
Fs 540	4	8 38	37 0 54 E	"	"	"	13	- 2.39	-19.63	± 0.65
Mean	1903.423						(8 photographs)		-16.36	<sup>p.e.</sup> ± 0.49

Star and No. of Plate	Date and G.M.T. Mid-exposure.			Expo- sure.	Hour- angle.	Slit- width.	Range of Spectrum.	Comp. Spect.	No. of Lines.	Velocity relative to Earth.	Velocity reduced to Sun.	Mean Error.	
<i><math>\alpha</math> Persei, 1903.</i>													
		h	m	m		mm.				km/sec.	km/sec.	e.	
Fs 498	Oct.	5	11 51	32	2 48 E	$\left\{ \begin{smallmatrix} 0.025 \\ (m=3) \end{smallmatrix} \right.$	$\left. \begin{smallmatrix} 4202 \\ 4405 \end{smallmatrix} \right\}$	Fe Spk.	14	-21.18	-1.85	$\pm 0.84$	
Fs 501		12	8 39	28	5 30 E	"	"	"	15	-23.37	-4.11	$\pm 1.19$	
Fs 507		21	7 59	28	5 35 E	"	"	"	19	-18.88	-4.78	$\pm 1.25$	
Fs 525	Nov.	14	12 14	28	0 15 W	"	"	"	16	-5.81	-1.95	$\pm 1.03$	
Fs 548	Dec.	14	7 18	26	2 42 E	"	"	"	12	+2.26	-7.33	$\pm 0.98$	
"	(remeasured)										+2.23	-7.36	$\pm 0.58$
Mean	1903.832									(5 photographs)	-4.56		p.e. $\pm 0.71$

 **$\beta$  Geminorum, 1903.**

Fm 394	Feb. 9	8 0	70	2 23 E	$\left\{ \begin{smallmatrix} 0.025 \\ (m=3) \end{smallmatrix} \right.$	$\left. \begin{smallmatrix} 4202 \\ 4326 \end{smallmatrix} \right\}$	Fe Spk.	13	+16.68	+3.04	$\pm 0.68$
Fm 410	Mar. 6	11 50	40	3 5 W	$\left\{ \begin{smallmatrix} 0.017 \\ (m=2) \end{smallmatrix} \right.$	"	"	13	+23.76	+0.06	$\pm 0.41$
Fm 413		7 12 10	50	3 29 W	"	"	"	14	+26.09	+1.95	$\pm 0.40$
Fm 414		16 8 25	40	0 20 W	"	"	"	12	+28.01	+1.70	$\pm 0.46$
Fm 419		21 10 12	42	2 25 W	"	"	"	13	+29.89	+2.38	$\pm 0.61$
Fs 547	Dec. 11	11 45	40	2 36 E	$\left\{ \begin{smallmatrix} 0.025 \\ (m=3) \end{smallmatrix} \right.$	"	"	9	-14.88	+2.61	$\pm 1.62$
Mean	1903.306							(6 photographs)	+1.96		$\pm 0.29$

 **$\alpha$  Boötis, 1903.**

Fm 422	Apr. 4	11 39	22	1 44 E	$\left\{ \begin{smallmatrix} 0.017 \\ (m=2) \end{smallmatrix} \right.$	$\left. \begin{smallmatrix} 4202 \\ 4326 \end{smallmatrix} \right\}$	Fe Spk.	14	-11.71	-7.25	$\pm 0.58$
Fm 423	" 7	11 0	20	2 11 E	"	"	"	14	-10.20	-7.00	$\pm 0.67$
Fm 424	" 8	11 10	20	1 57 E	"	"	"	14	-9.07	-6.33	$\pm 0.52$
Fm 425	" "	11 57	25	1 10 E	"	"	"	14	-9.79	-7.10	$\pm 0.41$
Fm 428	" 20	10 57	23	1 23 E	"	"	"	13	-3.65	-6.35	$\pm 1.15$
Fm 432	" 22	12 47	15	0 35 W	"	"	"	13	-3.10	-6.64	$\pm 0.71$
Fm 435	" 24	12 49	22	0 45 W	"	"	"	14	-1.60	-6.02	$\pm 0.81$
Fm 436	" 27	11 5	20	0 47 E	"	"	"	14	-2.89	-8.43	$\pm 0.61$
Fm 437	" "	11 56	21	0 4 W	"	"	"	14	-1.70	-7.32	$\pm 0.50$
Fm 438	" "	12 53	22	1 1 W	"	"	"	14	-0.76	-6.47	$\pm 0.63$
Fm 443	May 4	11 59	19	0 35 W	"	"	"	12	+4.62	-3.93	$\pm 0.55$
Fm 446	" 7	13 0	14	1 48 W	"	"	"	13	+4.79	-5.02	$\pm 0.62$
Fm 448	" 12	12 27	14	1 34 W	"	"	"	10	+6.75	-5.01	$\pm 0.77$
Fm 449	" 15	12 5	24	1 24 W	"	"	"	14	+7.49	-5.37	$\pm 0.41$
Fm 452	" 20	9 51	17	0 30 E	"	"	"	14	+6.03	-8.46	$\pm 0.79$

Star and No. of Plate.	Date and G.M.T. Mid-exposure.		Expo- sure.	Hour- angle.	Slit- width.	Range of Spectrum.	Comp. Spect.	No. of Lines.	Velocity relative to Earth.	Velocity reduced to Sun.	Mean Error
<b><math>\alpha</math> Boötis, 1903.</b>											
		h m	m		mm.				km/sec.	km/sec.	$\epsilon_0$ .
Fm 458	May 25	12 52	35 2	48 W	$\left\{ \begin{smallmatrix} 0.017 \\ (m=2) \end{smallmatrix} \right\}$	$\left\{ \begin{smallmatrix} 4202 \\ 4326 \end{smallmatrix} \right\}$	Fe Spk.	14	+ 8.31	- 7.76	$\pm 0.57$
Fm 461	" 26	11 13	14 1	15 W	"	"	"	13	+ 11.37	- 4.11	$\pm 0.54$
Fm 464	" 27	9 59	18 0	5 W	"	"	"	14	+ 8.56	- 8.30	$\pm 0.60$
Fm 466	June 2	9 44	18 0	14 W	"	"	"	13	+ 10.44	- 8.22	$\pm 0.88$
Mean	1903.333		(19 photographs)						- 6.58	$\pm 0.219$	p.e.
<b><math>\beta</math> Ophiuchi, 1903.</b>											
Fs 482	July 7	13 18	67 2	38 W	$\left\{ \begin{smallmatrix} 0.025 \\ (m=3) \end{smallmatrix} \right\}$	$\left\{ \begin{smallmatrix} 4202 \\ 4326 \end{smallmatrix} \right\}$	Fe Spk.	6	- 7.46	- 16.81	$\pm 4.24$
Fs 487	Aug. 4	10 25	80 1	35 W	"	"	"	7	+ 4.43	- 14.89	$\pm 1.96$
Mean	1903.551.		(2 photographs)						- 15.85		
<b><math>\gamma</math> Aquilæ, 1903</b>											
Fm 473	June 22	13 5	70 0	37 E	$\left\{ \begin{smallmatrix} 0.017 \\ (m=2) \end{smallmatrix} \right\}$	$\left\{ \begin{smallmatrix} 4202 \\ 4405 \end{smallmatrix} \right\}$	Fe Spk.	7	- 11.37	+ 0.87	$\pm 3.31$
Fs 485	July 24	11 45	70 0	44 W	$\left\{ \begin{smallmatrix} 0.025 \\ (m=3) \end{smallmatrix} \right\}$	"	"	11	- 1.94	- 2.71	$\pm 1.76$
Fs 488	Aug. 4	11 50	75 1	34 W	"	"	"	8	+ 3.14	- 2.31	$\pm 2.58$
Fs 492	" 7	11 15	78 1	13 W	"	"	"	10	+ 3.35	- 3.32	$\pm 1.87$
Mean	1903.555		(4 photographs)						- 1.87		
<b><math>\epsilon</math> Pegasi, 1903</b>											
Fs 502	Oct. 12	10 30	70 2	13 W	$\left\{ \begin{smallmatrix} 0.025 \\ (m=3) \end{smallmatrix} \right\}$	$\left\{ \begin{smallmatrix} 4260 \\ 4405 \end{smallmatrix} \right\}$	Fe Spk.	11	+ 23.68	+ 2.73	$\pm 1.66$
Fs 505	" 16	10 5	80 2	2 W	"	$\left\{ \begin{smallmatrix} 4202 \\ 4405 \end{smallmatrix} \right\}$	"	17	+ 27.07	+ 4.90	$\pm 1.63$
Fs 512	" 26	8 40	70 1	18 W	"	"	"	16	+ 26.99	+ 2.26	$\pm 1.44$
Mean	1903.795		(3 photographs)						+ 3.80		
<b><math>\epsilon</math> Leonis, 1903</b>											
Fm 415	Mar. 16	10 50	120 0	44 W	$\left\{ \begin{smallmatrix} 0.017 \\ (m=2) \end{smallmatrix} \right\}$	$\left\{ \begin{smallmatrix} 4202 \\ 4326 \end{smallmatrix} \right\}$	Fe Spk.	15	+ 21.39	+ 4.47	$\pm 0.81$
Fm 434	Apr. 24	12 15	90 4	42 W	"	"	"	11	+ 30.12	+ 1.95	$\pm 1.26$
Fm 440	May 2	9 20	70 2	19 W	"	"	"	9	+ 33.93	+ 5.04	$\pm 1.95$
Fm 447	" 12	9 42	65 3	20 W	"	"	"	6	+ 31.30	+ 1.88	$\pm 3.39$
Mean	1903.303		(4 photographs)						+ 3.84		
<b><math>\epsilon</math> Virginis, 1903</b>											
Fm 444	May 4	13 45	80 3	27 W	$\left\{ \begin{smallmatrix} 0.017 \\ (m=2) \end{smallmatrix} \right\}$	$\left\{ \begin{smallmatrix} 4202 \\ 4326 \end{smallmatrix} \right\}$	Fe Spk.	12	+ 0.31	- 15.76	$\pm 1.24$
Fm 445	" 7	11 48	76 1	50 W	"	"	"	13	+ 2.70	- 13.81	$\pm 0.83$
Mean	1903.342		(2 photographs)						- 14.78		

April 1905.

*Errata.*

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*Summary.*

Epoch.	Star.	No. of Photographs.	Velocity in Line of Sight.
1903·423	$\alpha$ Arietis	8	— 16·36 $\pm$ 0·49
1903·832	$\alpha$ Persei	5	— 4·56 $\pm$ 0·71
1903·306	$\beta$ Geminorum	6	+ 1·96 $\pm$ 0·29
1903·333	$\alpha$ Boötis	19	— 6·58 $\pm$ 0·22
1903·551	$\beta$ Ophiuchi	2	— 15·85
1903·555	$\gamma$ Aquilæ	4	— 1·87
1903·795	$\epsilon$ Pegasi	3	+ 3·30
1903·303	$\epsilon$ Leonis	4	+ 3·34
1903·342	$\epsilon$ Virginis	2	— 14·78

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*Errata in Mr. Nevill's Paper.*

*Monthly Notices*, vol. lxx. p. 267, first three lines.

*For*     — 0·51, — 1·01, — 1·83  
*read*    + 0·51, + 1·01, + 1·83.